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Executive Office of Energy Resources.

REPORT ON THE ELECTRICITY SUPPLY SITUATION OF JULY 24, 1987: CAUSES, RESPONSES, AND RECOMMENDATIONS

GOVERNMENT DOCUMENTS
COLLECTION

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I. Overview

On Friday, July 24, 1987, the New England region experienced an extremely tight power supply situation with the following operating conditions in effect that day.

While much of New England had been hot and humid all week, Friday was the first day that week that Boston had temperatures in the mid-90s. Since hot weather on a business day leads to high electricity demand, especially in urban areas, New England's utilities were expecting to hit a record-breaking peak of 17,800 megawatts ("MW") on Friday.

On top of a high number of large nuclear power plants already out of service for maintenance or refueling, an unusually high amount of additional generating capacity went out unexpectedly on Friday morning.

The combination of hot weather, high demand, and unusually high generation outages meant that in order to avoid interruptions to service, the New England Power Pool ("NEPOOL") had to operate the region's power supply system according to procedures designed to tap every bit of power in the system and to keep customer demand within the range that could be met by available plants. The operating procedures NEPOOL used on Friday included emergency purchases from neighboring utility systems, voltage reductions on transmission lines, and requests to large customers to voluntarily cut back on their electricity use.

The utilities' operation of the system and customers' responses to requests to reduce demand kept Friday's actual peak demand at 17,334 MW and enabled the region's utilities to avoid interrupting service to customers.

II. Power Supply: What Happened

The major factor, in addition to the heat, leading to Friday's tight capacity situation was the large number of power plant outages. Total outages through the day averaged approximately 5600 MW (representing about 25% of NEPOOL generating capacity). Of this total, 2356 MW (11% of NEPOOL generating capacity) represented plants scheduled for maintenance, including Millstone 1 (654 MW), Connecticut Yankee (569 MW), Pilgrim (667 MW), Middletown 3 (233 MW), a unit at Moore station (48 MW), and 185 MW of small gas turbines and hydro units.

The remaining 3300 MW (15% of NEPOOL generating capacity) represented what are referred to as "forced", "unscheduled" or "unplanned" outages at several power plants around the region. It was the magnitude of these outages, in combination with high loads resulting from the weather, that led to the need to implement the higher steps in NEPOOL's "Operating Procedure #4" ("OP 4").

Description of Plant Outages

As of 8:00 a.m., NEPOOL was aware that five major generating stations totalling 1688 MW would be out of service on Friday for unplanned maintenance. In addition, a sixth plant, Millstone 2, would be coming back from an outage on Thursday, July 23, and would not be at full power until mid or late afternoon. In mid-morning NEPOOL lost two more major generating stations totalling 755 MW. At 9:30 a.m. Merrimack 2, a 320 MW coal-fired plant in Bow, New Hampshire went out of service, and at approximately 10:30 a.m. Salem Harbor 4, a 435 MW oil-fired plant in Salem, Massachusetts went out of service.

A list and brief description of the status and problems at each of the plants unexpectedly out of service on Friday follows. This information is provided as reported to us by the utilities.

Millstone 2, an 843 MW nuclear plant owned primarily by Northeast Utilities, went out of service on Thursday, July 23, because of a pressurizer spray valve problem that resulted in an inability to control the pressure in the pressurizer. It was repaired and the plant was returned to service at midnight. By 8:00 a.m. it was generating about 50% capacity or 486 MW; by 10:00 a.m. 546 MW; by noon 601 MW; by 2 p.m. 646; and returned to full power by 5:00 p.m. Millstone 2 was last out of service for scheduled maintenance and refueling from mid-September to mid-December 1986.

Brayton Point 4, a 421 MW oil-fired plant owned by New England Electric System, was taken out of service on July 23 because of water losses in the boiler; five separate leaks were discovered in the boiler tubes. The leaks were repaired and the plant returned to service on July 25 at 1:19 a.m. It provided no power on Friday, July 24. Brayton Point 4 was last out of service for scheduled maintenance during the weeks ending May 16 to June 20, 1987.

Mystic 5, a 135 MW oil-fired plant owned by Boston Edison Company, went out of service on July 23 because of a tube leak in the primary superheater (the device that "superheats" saturated steam before it is fed to the turbine). The leak was repaired and operators tried to return the unit to service at 8:30 a.m. on Friday, July 24, when they discovered an unrelated problem with a valve in the condenser system. This was repaired and the unit returned to service on July 26. It provided no power on Friday, July 24. Mystic 5 was last out of service for scheduled maintenance and inspection in July 1986 and is due out again in January 1988.

Mystic 6, a 141 MW oil-fired plant owned by Boston Edison Company, went out of service on July 16 for chemical cleaning and repair of waterwall tube leaks in the boiler. Cleaning was completed on July 20 and repairs of discovered leaks began. These were completed and the unit returned to service at 11:21 p.m. on July 24. It provided no power during the peak period on Friday, July 24. Mystic 6 was last out of service for one week of scheduled maintenance and inspection in June 1986 and is due out next in November 1987.

Salem Harbor 3, a 146 MW coal-fired plant owned by New England Electric System, went out of service on July 23 because of a large boiler tube leak tentatively identified as caused by localized overheating. Fifty feet of tube were replaced. The plant returned to service on July 26 at 2:20 p.m. It provided no power on Friday, July 24. Salem Harbor 3 was last out of service for scheduled maintenance during the weeks ending March 28 to May 16, 1987.

Maine Yankee, an 845 MW nuclear plant owned by the Maine Yankee Atomic Power Co., went out of service for maintenance the week ending April 4, 1987 and was scheduled to return to service May 30, 1987. On its return to service, the unit experienced vibration problems with its low pressure turbines (on the non-nuclear side). It went out of service for repairs on July 16, 1987 and is now scheduled to return to

service on September 7, 1987. It provided no power on Friday, July 24, 1987.

Merrimack 2, a 320 MW coal-fired plant owned by Public Service of New Hampshire, went out of service at approximately 9:30 a.m. on Friday, July 24, because of a coal feeder problem. The plant's operators wanted to keep it out of service to fix some persistent boiler tube leaks; however they responded to NEPOOL's request to return it to service quickly because of the day's load and capacity situation. The feeder was repaired and the unit returned to service at about 11:45 a.m. and was up to full power by 4:00 p.m. (The delay in return to full power was due in part to the persistent tube leaks.) Merrimack 2 was last out of service for scheduled maintenance during the weeks ending March 28 to June 13, 1987.

Salem Harbor 4, a 435 MW oil-fired plant owned by New England Electric System, went out of service at 10:35 a.m. on Friday, July 24, because of the failure of an O-ring in an hydraulic line at the joint with the boiler feed pump turbine steam inlet valve which led to a loss of hydraulic fluid. The O-ring was replaced and the unit returned to service at 11:00 p.m. that evening. It provided no power during the peak hours on July 24. Salem Harbor 3 was last out of service for scheduled maintenance for two weeks from June 28 to July 11, 1987.

In addition to the major power plants discussed above, several other small units were either out of service or operating at levels below their rated capacity, resulting in total unplanned outages during the day as indicated in the table below.

Total Unplanned Outages (MW)	Hour Ending
3309	10:00
3497	11:00
3418	12:00
3387	1:00
3440	2:00
3253	3:00
3195	4:00
3209	5:00
3199	6:00
3141	7:00

Planning for Unplanned Outages

In scheduling maintenance of plants and assessing the adequacy of its operational capacity to meet demand in any

week, NEPOOL allows for a certain number of MW of unplanned outages during any particular day. In the last two years NEPOOL has projected unplanned outages at a level of 2000 MW per day. In earlier years the allowance had been 2500 MW. NEPOOL's rationale for lowering the unplanned outage estimate for this year was based on two factors. First, NEPOOL says that it has seen a "slow but subtle" improvement in the availability of its generating units in the last few years. Second, with the implementation of the new Performance Improvement Program ("PIP") NEPOOL expects that this improvement in availability will continue.

NEPOOL does not adjust unplanned outage estimates by season, or time or type (weekday, weekend) of day. NEPOOL representatives indicated that while outages did not correlate with weather (i.e., outages are not more likely for engineering reasons because it is hot or cold), they did appear to be affected by factors that are indirectly related to the weather such as increased output requirements resulting from high demand. In the summer and winter, when loads on the electric system are higher NEPOOL must run units at their maximum capability more often. In addition, units which cycle on and off in the spring and fall run continuously at summer and winter peak load times. Operation at maximum capability strains units and makes them more susceptible to forced outages. Likewise, cycling units, which in the off-season may have minor repairs made when the are down, are more likely to experience outages when run continuously.

A comparison of last year's actual forced outage level with this year's estimate indicates that NEPOOL may have been optimistic in projecting unplanned outages at only 2000 MW, particularly during the summer. In 1986 NEPOOL experienced an annual average of 2400 MW of unplanned outages at week day peak times. For the summer months from June 1, 1986 to September 15, 1986, this average was even higher at 2500 MW even though demand on the system was low given the cooler than normal summer New England experienced. Furthermore, during July 1986 when NEPOOL experienced the summer 1986 peak, the average week day forced outage level was extremely high at 3488 MW. While the monthly average unplanned outage level at week day peak times for June 1987 was only 1732 MW, there were nine week days where outages exceeded 2000 MW including Monday, June 15 (the overall June 1987 peak day) when unplanned outages reached 2700 MW.

The nature of the problems that developed at the kinds of power plants that experienced outages on Friday further suggests that NEPOOL's operational planning estimate of 2000 MW may have been optimistic for unplanned outages during the summer season. Four of the eight plants -- Mystic 5 and 6, Salem Harbor 4 and Brayton Point 4 -- are cycling units. Three of these plants were out of service because of a variety of

tube leaks, a problem that NEPOOL spokesmen identified as relatively common when plants are run frequently at maximum capability or cycling units are run continuously. A fourth plant -- Merrimack 2 -- was also having problems with tube leaks although it was able to return to service before Friday afternoon's peak.

Lastly, the size of some of the power plants that were out of service on Friday illustrates again the particularly adverse impact that the loss of large plants has on the NEPOOL system as a whole. Two of the units that were unexpectedly partially or completely unavailable were large (850 MW) nuclear units. Forced outages do not appear to be correlated with the size of units. However, when one large plant goes out, its negative impact on the remaining available capability is greater than if one smaller plant goes out. Therefore, the more large power plants there are in the system the greater the negative impact of losing any individual plant.

III. What the Utilities Did In Response

Even before Merrimack 2 and Salem Harbor 4 went out unexpectedly on Friday morning, NEPOOL already had been expecting to have to use various steps in its Operating Procedure #4 in order to manage a very tight power supply situation.

On Thursday evening, the outlook for Friday was tight but manageable:

> The week before, Maine Yankee had gone down unexpectedly for an extended repair.
>
> On Thursday afternoon, Millstone 2 also had gone down unexpectedly, with a prognosis for it to start operating again at at least partial power during Friday's peak.
>
> It looked as though New England's hot and humid weather would finally hit Boston.
>
> With Boston hot, NEPOOL expected to have to use the first four steps of OP 4 but not to have to reach the steps requiring voltage reduction on transmission lines or public appeals to customers to curtail their electricity use. (See the Attachment for the steps available under OP 4.)

Friday started as NEPOOL operators had expected, with Millstone 2 returning to half power by 8 a.m. An hour later, as demand picked up, NEPOOL implemented Actions 1 and 2 of OP 4: running all available plants at their maximum output levels. These actions amounted to about 155 MW of extra output New-England wide.

However, the operational situation soon changed dramatically as two more plants went out in rapid succession:

> At 9:30 a.m., Merrimack 2 went out.
>
> NEPOOL immediately implemented other steps under OP 4, much sooner than NEPOOL had expected them to be needed on Friday.
>
> Under Action 3, NEPOOL can try to obtain additional power by making emergency purchases from neighboring power systems (from the New York Power Pool, and from New Brunswick and Hydro Quebec in Canada). Such purchases are limited by the amount of power those neighbors have to spare at any hour, and by the availability of room on the existing transmission lines tying them to New England. Through a new agreement

recently completed with Maine utilities, NEPOOL is authorized to buy capacity on an hour-to-hour basis to completely fill up the lines between New Brunswick and New England.

> While availability of power from Canada looked good all day, at the beginning of Friday NEPOOL did not expect to be able to get much if any emergency power from New York since New York was also experiencing peak demand conditions.
>
> After implementing Step 3 at 9:25, by 10:00 NEPOOL was obtaining 250 MW through emergency purchases, principally over the lines to Canada.
>
> (Additionally, NEPOOL managed to fully utilize its two direct transmission interconnections with Hydro Quebec, which amounted to 907 MW of non-emergency capacity over the entire peakload period on Friday.)

Under another step, NEPOOL can use an accounting device to reduce the amount of generating capacity required to be held in reserve to cover any new unexpected plant outages. Under this step, NEPOOL reduces its operating reserve requirement by the amount the system could achieve through voltage reductions if such reductions had to be implemented.

> Starting at 9:30, implementing this step reduced NEPOOL's operating requirements by 150 MW, of the level of "load relief" NEPOOL assumed to be achievable from reducing voltage levels during summer peak conditions.

Under other steps available as part of Actions 4 and 5, introduced at 9:45 a.m., NEPOOL tried to decrease peak demand by calling upon specific "interruptible" customers to voluntarily reduce their demand. These customers are ones who have recently entered into contracts with NEPOOL to drop load voluntarily at NEPOOL's request and to receive a small payment for any "load curtailment" they actually perform.

> After NEPOOL began to call on these interruptible customers at 9:45, customers began to respond quickly, contributing 118 MW by 10:00, and up to 136 MW by 11:00 a.m.

Then, at 10:30, when Salem Harbor 4 went down unexpectedly, an already tight situation worsened. Even with interruptible customers beginning to drop off their loads, demand was approaching 17,000 MW, which was already higher than the 1987 summer peak to date (16,591 MW, reached on July 10th).

NEPOOL immediately had to go to OP 4 actions that it had not expected to have to use on Friday:

> Under another step of Action 4, NEPOOL called on all electric utilities in New England to reduce their own loads, by (1) turning off lights and any unnecessary equipment at their own installations and (2) calling upon customers with existing emergency generators to turn them on and to drop load off the utility system.
>
> > After beginning to implement this step around 10:30, NEPOOL gained 30 MW from these utility actions.
>
> Under Actions 4 and 6, NEPOOL again used accounting devices to reduce even further the amount of back-up generation needed to be held in operating reserve to cover a new unexpected plant outage.
>
> > After implementing these actions just before 11:00, NEPOOL effectively gained nearly 600 MW for the system.

Also at 10:30 a.m., NEPOOL received word from the New York Power Pool that due to unexpectedly low power plant outages there, New York could provide NEPOOL with extra emergency power purchases, amounting to a complete back-up of NEPOOL's operating reserve. This offer helped NEPOOL recover from the capacity problems brought on by its unusually high unplanned outages.

> By 11:00, this additional back-up capacity from New York raised NEPOOL's total emergency purchases to 450 MW.
>
> By noon, emergency purchases totalled 800 MW.
>
> For the rest of the afternoon peak period, total emergency purchases remained above 500 MW.

As New England's demand kept rising between 11:00 and 12:00, it surpassed the previous summer peak of 17,059 (experienced in 1985), and utilities had to go to Action 7 of OP 4 -- reducing voltage on New England's transmission lines.

> After NEPOOL implemented a 5-percent voltage reduction on part of the system's power lines at 11:30 a.m., within 10 minutes the system load went down 120 MW.
>
> After 12:00, as demand continued to rise, NEPOOL reduced voltage on the rest of the system, so that total voltage reductions amounted to 235 MW during the afternoon peak period.

Over at least the preceding hour, discussions were beginning to take place among utility executives and NEPOOL operators about whether and when to implement the final action of OP 4 -- radio and TV broadcasts to appeal to all New England customers to voluntarily conserve electricity. In particular, Northeast Utilities was urging the head of NEPOOL's Executive Committee to implement Action 8's public appeals for voluntary conservation. NEPOOL's leadership decided around noontime that NEPOOL would not implement that step, at least at that point in the day.

From past experience in tracking peak demand on hot summer days, the utilities were expecting that demand could rise another 300-400 MW above the load experienced in late morning.

If that were to happen on Friday, when the noon load was 17,318 MW -- even after the first portion of voltage regulation was implemented -- some utility executives were afraid that demand would go higher than the generating system could bear that day.

Starting in late morning, many of these executives authorized their own companies to telephone their largest customers to ask them to cut off any unnecessary electricity equipment.

From informal reports received by state energy offices in Connecticut and Massachusetts, many large customers cooperated with these utility requests over the course of the afternoon peak period.

Several utilities also decided to go to public appeals in their own service territories:

Northeast Utilities, with service territories in Connecticut and Western Massachusetts, decided to go to radio appeals starting around noon and notified Massachusetts energy officials of that fact around 12:30.

Northeast Utilities executives also notified Connecticut Governor William O'Neill of the Company's intention to make public appeals and recommended that he make a public announcement encouraging Connecticut citizens to conserve electricity. Governor O'Neill made such an announcement around 12:30.

United Illuminating, also of Connecticut, made public appeals in its service territory.

Additionally, several Vermont companies made public appeals in their service territories.

Between noon and 2:00 p.m., the pace of increase in customer demand began to slow:

> A new record-breaking summer peak of 17,334 MW occured around 2:00.
>
> Thereafter, demand began to drop slowly: By 3:00, demand was 17,258 MW; by 4:00, it was 17,066 MW; by 5:00, it was 16,983 MW.

Over the course of the afternoon peak period, NEPOOL operators cautiously maintained the status of the system, with all of the first seven steps of OP 4 in full force. The operators remained concerned that even though demand was not continuing to rise, the situation could worsen dramatically if yet another large power plant went out of service unexpectedly.

Fortunately, that did not happen. By 4:15 p.m., NEPOOL felt confident enough to restore full voltage to nearly all of the system's transmission lines. By 4:30, NEPOOL further terminated its efforts under Actions 5 and 6 of OP 4. Around 5:00, NEPOOL lifted Actions 4, 2 and 1, but retained Action 3 (emergency purchases for backing up reserves) until 7:00.

Over the course of the day, there were on-going communications between state officials and utility spokesmen. At a minimum, NEPOOL's rules require the utilities to notify certain state energy officials when NEPOOL implements Action 5 under OP 4. Utility representatives did provide such notification. Clearly, though, representatives in certain states sought further updates on other actions anticipated or implemented by NEPOOL and individual utility companies. At times, these other communications between Massachusetts officials and the utilities were somewhat uncoordinated, in that officials from various state energy agencies were contacting a variety of different utility representatives to obtain up-to-the-minute status reports on peak load conditions, power plant operations, and NEPOOL's implementation of actions under OP 4.

IV. Findings and Recommendations

The following findings and recommendations are based on the facts and observations discussed above and other sources of relevant information as indicated.

Finding #1 The supply situation in New England on July 24th, while tight, was within national electric industry standards for reliability.

The use of Operating Procedure #4 was an appropriate immediate response by NEPOOL to conditions on a hot summer day with heavy customer loads and high forced outages of generating units. Procurement of excess power from other regions, voltage reductions, and the other supply enhancement/load reduction steps of OP 4 were reasonable measures to take under such conditions. Consumers actually benefited from use of OP 4 as an alternative to financing expensive new power plants for use during only a few hours per year.

> **Recommendation:** The Commonwealth and NEPOOL should increase efforts to educate the public about the nature and benefits of the use of OP 4. Specifically, the use of OP 4 should always be distinguished from the concept of "blackouts" which involve involuntary interruption of service to consumers.

Finding #2 NEPOOL's planning assumptions for unplanned/forced outages for the period including July 24th were unrealistically low.

NEPOOL had assumed that forced outages for this summer would average about 2000 MW. This appears to have been overly optimistic for three reasons. First, forced outages averaged 2500 MW last summer and hit almost 3500 MW last July, the month when last year's summer peak occurred. Second, last summer was quite cool, producing less stress on the system, which in turn led to lower forced outage levels than expected under normal summer weather conditions. Third, peak demand this summer was expected to be 13 percent higher than last; therefore, units would be expected to have to run continuously for longer periods producing more stress on the system and the likelihood of "clusters" of outages. Taken together, these factors point to higher, not lower, planning assumptions regarding levels of forced outages. While the forced outages of 3300 MW on July 24th were perhaps higher than even a reasonable forecast would have predicted, NEPOOL was unrealistic in planning for a declining outage level of 2000 MW.

Recommendation: Future planning assumptions for forced outages used by NEPOOL should err on the side of realism. While NEPOOL justified its estimate based on recent improvements in plant availability, the other factors cited above such as load and weather should be given more weight in estimating a forced outage level to assume for planning system operations, especially during critical seasonal peak periods.

Finding #3 High forced outages at peak periods are further evidence of the need for NEPOOL and its members to improve maintenance practices and replacement power pricing policies.

On July 24th, approximately 5600 MW of capacity or a fourth of New England's capacity, was down. Of that, 2356 MW were out for scheduled maintenance, and 3300 were unexpectedly unavailable. The unavailability of a fourth of the power pool's capacity on a peak summer day is further evidence of the need for improved maintenance practices and pricing policies.

The public utility commissions of the six New England states have aggressively pursued this chronic problem over the past two years, and most recently by intervening at the Federal Energy Regulatory Commission (FERC) in a proceeding addressing this very issue. As of May 21st, 1987, four of the six New England states (MA, RI, CN and NH) entered into a settlement agreement with NEPOOL which should improve maintenance practices and pricing policies substantially. If accepted by the FERC, this settlement should provide more financial incentives to invest in maintenance and higher financial penalties for poor reliability of power plants.

While NEPOOL had recently initiated a Performance Improvement Program (PIP) of its own, it is a pale version of that contemplated in the settlement. The terms of the settlement should accelerate that effort substantially.

Recommendations: First, all parties to that settlement should urge FERC to expedite acceptance of the settlement as quickly as possible. In anticipation of FERC's approval, NEPOOL should expedite planning efforts to fully implement the terms of the settlement.

Second, in addition to FERC action on this settlement, the Massachusetts Department of Public Utilities will continue to strictly enforce performance requirements for power plants via annual proceedings under MGL Chapter 164 94G. By so doing, any unreasonable performance will result in denial of recovery of fuel or replacement power costs.

Finding #4 There is a disparity between NEPOOL's expressed level of concern regarding tight supplies this summer and NEPOOL's level of concrete action to ensure reliable service.

Overall, given the extremely high loads they faced starting on Friday morning, along with the extremely tight capacity situation they were forced to deal with starting mid-morning, NEPOOL's operators appear to have managed the power supply system very competently over the course of the day.

Still, we note that however tight the situation actually turned out to be on Friday, New England actually did not experience "worst-case" operational conditions that day. The situation would have been worse if any or some combination of the following conditions had occurred:

1. if the New York Power Pool had had typical or high unplanned power plant outages;
2. if Friday had followed upon a previously hot and humid day in urban Boston as well as throughout New England;
3. if Millstone 2 had not returned even to partial power over the course of Friday; and
4. if any other large power plant in New England had gone out during the peak period on Friday.

Since last March, it has been apparent to NEPOOL and the Commonwealth that neither Pilgrim Station nor Seabrook Station would have NRC approval to operate by this summer. The supply situation for the summer has been analyzed by the Commonwealth as being tight but manageable unless extraordinarily hot weather or high forced outages occurred. While NEPOOL generally concurred with that assessment, it has emphasized repeatedly that some risk of involuntary curtailment of service existed for this summer.

To its credit, NEPOOL has identified approximately 130 MW of new interruptible load, with the help of the Maine Public Utilities Commission. In addition, the unexpected loss of Maine Yankee has been mitigated, in part, by a new agreement to receive power over the transmission ties with New Brunswick.

Beyond that, however, there is no evidence of an aggressive, organized effort by NEPOOL or its members to pursue additional demand-side options to reduce load for this summer's peak periods. NEPOOL has been unable to cite specific actions

or programs instituted specifically for this purpose, much less any results of such efforts.

While the Commonwealth recognizes that NEPOOL is merely a voluntary organization, held together by member consensus and cooperation, its lack of leadership in initiating or suggesting aggressive demand-side efforts for this summer is puzzling. The disparity between the tone of public statements regarding the summer situation versus the level of coordinated effort to maximize demand-side options to deal with problem hours is significant.

Recommendation: To enhance NEPOOL's capabilities generally and under OP 4 specifically, NEPOOL should revise the NEPOOL agreement wherever necessary to ensure that it provides adequate incentives to member companies to take appropriate actions to develop power supply options such as:

1. emergency back-up generator contracts;
2. voluntary and mandatory interruptible load contracts; and
3. commercial/industrial customer load-shedding cooperatives.

To take full advantage of the diversity of member companies' resources and loads, incentives should be put into place and priced so that they encourage companies to pursue options that may be available to them -- but not needed by them to meet their own loads -- for the benefit of other companies or NEPOOL as a whole.

NEPOOL should also incorporate into the CELT Report data collection effort reporting requirements for members to indicate if individual companies are pursuing options along the lines discussed above.

Concurrently, the Energy Facilities Siting Council (EFSC) should amend its reporting requirements for utilities under its jurisdiction to require that the same information specified above is provided by each company in its annual filing to the EFSC.

Finding #5 Forced outages of large units cause large replacement power problems.

The forced outages on July 24th illustrate in practical terms a major drawback of heavy reliance on large central

generating plants: the loss of each large unit causes large replacement power problems (regardless of fuel type) requiring that NEPOOL members' put into place and pay for reserve capacity adequate to maintain reliability under these circumstances.

Recommendations: Given the effects of large plants on reserve requirements and system reliability, the utilities should develop and implement least-cost planning processes that recognize these adverse effects.

Further, NEPOOL should revise provisions regarding reserve requirements in its agreement that give utilities inappropriate incentives toward building large plants.

Finding #6 Lines of communication during OP 4 need to be refined between the Commonwealth and NEPOOL and within the Commonwealth.

The discussion in part III of this report details some of the communication problems which occurred on July 24th. While none of these problems had an adverse impact on the supply situation, there is room for improvement.

Recommendations: With respect to communication between the Commonwealth and NEPOOL:

1. one person from NEPOOL should be designated as Massachusetts' liaison for the duration of an OP 4 situation;
2. the Secretary of Energy Resources or her designee should be the main contact for the Commonwealth with the NEPOOL liaison for the Commonwealth during the event except at step 5 of OP 4, when the DPU and the EFSC should also receive direct notice from NEPOOL;
3. the designated NEPOOL liaison should provide automatic status reports by phone at least every half hour during OP 4 beyond step 3; and
4. NEPOOL should update the list of Massachusetts contact people noted in its special operating procedures.

Within the Commonwealth, the following steps should be taken:

1. planned formal communication flows should be established in writing immediately by EOER to indicate how information from NEPOOL will be communicated to the Governor, Lt. Governor, the DPU, and other state agencies; and
2. a procedure for assisting NEPOOL and the utilities in implementing Step 8 of OP 4 (public appeals) should be formalized by EOER with NEPOOL.

ATTACHMENTS

OPERATING PROCEDURE NO. 4

	ACTION
Steam Generation to MCC	1
ICU Generation to MCC	2
Purchase Emergency Capacity and/or Energy	3
Curtail Interruptible Loads Qualifying as 30-Minute Reserve	
Voluntary Load Curtailment of NEPOOL Participants' Facilities	4
Customer Generation Contractually Available to NEPOOL Participants	
Curtail Interruptible Loads Requiring More Than 10 Minutes and not Qualifying as Operating Reserve	
* Curtail Interruptible Loads Qualifying as 10-Minute Reserve	5
Implementation of a 5% Voltage Reduction Requiring More Than 10 Minutes	6
Curtailment of Interruptible Loads Requiring 10 Minutes or Less	7
Implementation of a 5% Voltage Reduction Requiring 10 Minutes or Less	
Customer Generation Not Contractually Available to NEPOOL Participants	8
** Voluntary Load Curtailment From Large Industrial and Commercial Customers	
** Radio and TV Appeals for Voluntary Load Curtailment	

PRELIMINARY

Analysis of Generating Capability available during hours of OP 4 implementation on July 24, 1987.

(Data in MW)

	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
1. Net Installed Reserve Claimed Capability:	22,053	22,053	22,053	22,053	22,053	22,053	22,053	22,053	22,053	22,053
a) Short-term capacity from NBEPC:	200	200	200	200	200	200	200	200	200	200
b) Devon 3 Test Power:	68	68	68	68	68	68	68	68	68	68
2. Total Planned Maintenance:	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356	2,356
3. Total Unplanned Outages:	3,309	3,497	3,418	3,387	3,440	3,253	3,195	3,209	3,199	3,141
4. Net Capability Available: (Lines 1+1a+1b-2-3)	16,656	16,468	16,547	16,578	16,525	16,712	16,770	16,756	16,766	16,824
5. Load:										
a) Preliminary Integrated Load	16,494	17,072	17,318	17,132	17,334	17,258	17,066	16,983	16,648	16,143
**** b) Estimated Load without OP4 relief	16,612	17,208	17,572	17,505	17,707	17,631	17,439	17,179	16,648	16,143
6. Required Operating Reserve: Millstone Pt. 3 1110	1,665	1,665	1,665	1,665	1,665	1,665	1,665	1,665	1,665	1,665
7. Required Capability: (Lines 5b & 6)	18,277	18,873	19,237	19,170	19,372	19,296	19,104	18,844	18,313	17,808
8. Deficiency (Lines 4-7)	-1,621	-2,405	-2,690	-2,592	-2,847	-2,584	-2,334	-2,088	-1,547	-984
9. Hydro Quebec Phase 1	690	690	690	690	690	690	690	690	690	690
10. OP No. 4:										
a) Util. Max. Claimed Cap.	155	155	155	155	155	155	155	155	0	0
b) Purchase Emergency Capacity and/or Energy	249	449	800	600	500	500	522	549	550	250
** c) Count Voltage Reduction Avail. in 10 Mins. as Reserve	150	150	75	0	0	0	0	177	0	0
d) Curtail all NEPOOL Interruptible Loads	118	136	136	136	136	136	136	136	0	0
e) Customer Generation Contractually Avail. and Part. Vol. Curtailment	29	29	29	29	29	29	29	29	29	0
* f) Allow 30 Min. Res. to go to Zero (555 MW required)	27	555	484	542	555	555	362	89	75	0
* g) Allow 10 Min. Reserve to be depleted to as little as 200 MW of synchronized reserve	0	38	0	0	342	79	0	0	0	0
h) Curtail NU sale to LILCO (Availability of MPT 2)	203	203	203	203	203	203	203	203	203	203
*** i) Implement Voltage Reduction	0	0	118	237	237	237	237	60	0	0
j) Appeal for Non-Contractual Customer Gen. and Voluntary Customer Load Curtailment. (Radio and TV appeals)	0	0	0	0	0	0	0	0	0	0
k) Remaining deficiency after OP #4 relief	0	0	0	0	0	0	0	0	0	159

* Does not provide capacity but reduces requirement against which the deficiency is measured.
** 150 MW was maximum load relief expected from summer time voltage reductions.
*** When voltage reduction is implemented, counting voltage reduction as reserve is eliminated.
**** No projection of the effect of voluntary load curtailment has been included in these load estimates.

NEPEX Forecasting 7/27/87

NEPOOL

NEPEX

July 27, 1987

TO: NEPOOL Operations Committee

FROM: E. Kenneth Nielsen Ken

SUBJECT: Generating Capacity Shortage - Friday, July 24, 1987

The entire New England Area experienced very warm, humid weather on Friday. High temperatures in Hartford and Boston (Logan Airport) were 96°F and 95°F, respectively. While Hartford has been very hot all week, it was the first day of such weather for Boston. We estimate that the peak load would have been 17,800 MW had load relief not been implemented, nearly 500 MW more than the actual load. Generation outages and reductions were high. While Millstone Point 2 was back in service from a forced outage which occurred on Thursday, Salem Harbor 4 and Merrimack 2 tripped. Merrimack 2 was back on line by late morning.

Voltages conditions in Connecticut were much improved over the previous day, primarily due to the return of Millstone Point 2. Voltages in Northeast Massachusetts were below normal due to the Salem Harbor 4 outage coupled with high loads. Voluntary load curtailment by large commercial and industrial customers in Eastern Massachusetts was requested to bolster voltage. Imports from NB Power had to be cut back from 700 MW to 650 MW due to low 345 KV voltages at Orrington. The on-going Maine Yankee outage was a primary cause of this problem.

Imports from NYPP and exports from CONVEX to the rest of NEPOOL were at their transfer limits. NYPP was able to deliver 500 MW of emergency capacity to NEPOOL due to above normal generator availability.

We estimate that the 5% voltage reduction resulted in 237 MW of load relief. This was the first full-scale voltage reduction ordered as an emergency action since the early 1970's. All NEPOOL interruptible loads were requested to be curtailed, including the new contract/voluntary interruptible loads.

New England Power Exchange 174 Brush Hill Avenue/P.O. Box 2010/West Springfield, MA 01090/(413) 787-9000

A summary of conditions in the hour ending 1400 (preliminary data) is as follows:

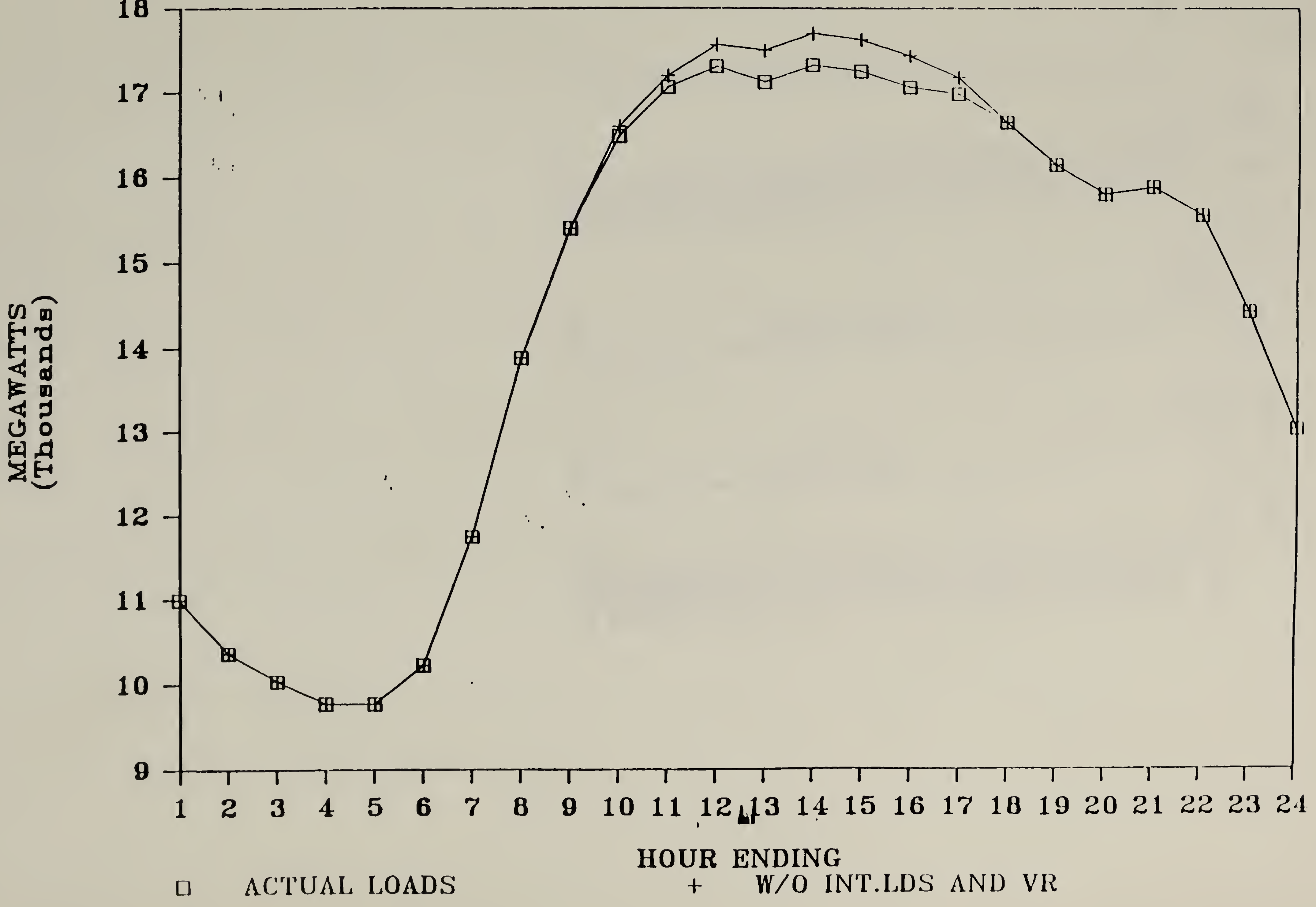
			MW
1.	Reserve Claimed Capability		21,359
2.	Planned Outages		2,356
3.	Unplanned Outages and Reductions		3,440
4.	Net Purchases from:	NYPP	201
		NB Power	651
		HQ	907
5.	Total Available Capacity		17,322
6.	Load		17,334
7.	Operating Reserve Requirement		1,668
8.	Net Capability Required		19,002
9.	Capacity Deficiency		1,680
10.	Emergency Capacity Purchased		500
10a.	Emergency Energy Purchased w/o Capacity		300
11.	Maximum Claimed Capability Achieved		
		Thermal	105
		ICU	50
12.	Additional Emergency Capacity Available		
		NYPP - 0	
		NB Power - 0	
		HQ - 0	
13.	Implementation of OP 4 Action	1	0900 to 1707
		2	0925 to 1707
		3	0925 to 1900
		4	0948 to 1700
		5	1025 to 1630
		6	1055 to 1630
		7	1130 to 1615

EKN:mp:NAM30

cc: Master-Satellite Heads
NEPOOL Planning Committee

NEPOOL LOADS ON JULY 24,1987

PRELIMINARY DATA



JULY 24, 1987 PRELIMINARY LOADS

HOUR	ACTUAL LOAD	INTERRUPT LOAD	VOLTAGE REDUCT	ESTIMATED LOAD
1	10996	0	0	10996
2	10372	0	0	10372
3	10036	0	0	10036
4	9774	0	0	9774
5	9775	0	0	9775
6	10223	0	0	10223
7	11742	0	0	11742
8	13882	0	0	13882
9	15401	0	0	15401
10	16494	118	0	16612
11	17072	136	0	17208
12	17318	136	118	17572
13	17132	136	237	17505
14	17334	136	237	17707
15	17258	136	237	17631
16	17066	136	237	17439
17	16983	136	60	17179
18	16648	0	0	16648
19	16143	0	0	16143
20	15797	0	0	15797
21	15880	0	0	15880
22	15555	0	0	15555
23	14436	0	0	14436
24	13034	0	0	13034
	346353	1070	1126	348549